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MISCELLANEOUS

Coherent X-Ray Diffraction Imaging of Nanoengineered Polymeric Capsules[1]

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For the first time, nanoengineered polymeric capsules and their architecture have been studied with coherent X-ray diffraction imaging technique. The use of coherent X-ray diffraction imaging technique allowed us to analyze the samples immersed in a liquid. We report about the significant difference between polymeric capsule architectures under dry and liquid conditions.

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Since the first publication in 1998 [1], nanoengineered polymeric capsules (NPCs) attract attention of numerous groups in the scientific world due to their unique properties. These are hollow objects with a shell thickness of 4 nm or more. Shell permeability can be varied by, for example, pH decrease in the environmental medium [2]. Architecture of the shell can be realized with nm resolution and can contain different polymers, biomolecules, including proteins, and even inorganic magnetic nanoparticles [3].

Such properties of NPCs highlight them as very promising systems for the biomedical applications. In particular, they were considered as ideal containers for pharmaceutical preparations [4]. In fact, they allow using the whole internal volume of the core for loading with drug molecules, while the shell architecture will provide smart functionality: targeted delivery and triggered release. It will guarantee the delivery of the containers in zones of risk and will release active preparations only when the disease will occur.

Obviously, the design of the most effective architectures of NPCs demands their detailed structural characterization. Several techniques were successfully used for these reasons, such as scanning electron microscopy (SEM), transmission electron microscopy (TEM) and atomic force microscopy (AFM) [3]. Even if these microscopies were very useful for the characterization of these objects, all of them have one significant drawback: measurements were performed under dry conditions, where the structure of capsules can be different from that in a liquid phase, which is a natural medium for biomedical applications. In addition, in the case of SEM and TEM, measurements are performed in vacuum by using electron beam, what make additional disturbances to the structure of these objects. In the case of AFM, some mechanical stresses can also significantly disturb NPCs structure. For all cases, the state of the sample in the core of the capsule cannot be resolved.

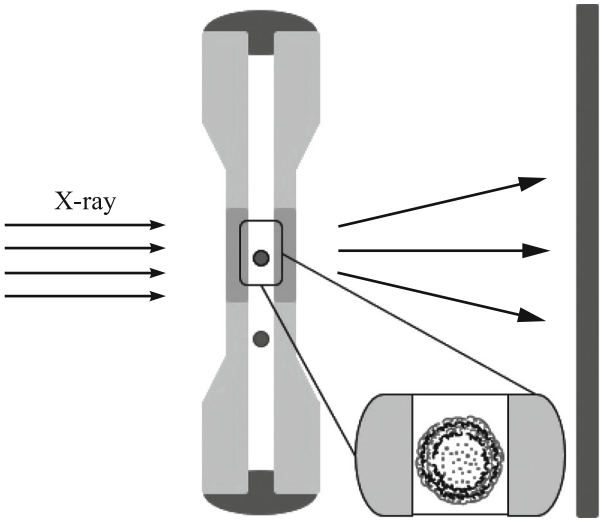

Fig. 1. Scheme of the experiment: NPC solution is placed between 100-nm-thick silicon nitrate membranes.

[1] The article is published in the original.